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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Masahiko YAMADA

Appln. No.: 09/978,275

Confirmation No.: 4449

Filed: October 17, 2001

Docket No: Q66727

Group Art Unit: 2623

Examiner: Anthony M. MACKOWEY

For: APPARATUS FOR SUPPRESSING NOISE BY ADAPTING FILTER CHARACTERISTICS TO INPUT IMAGE SIGNAL BASED ON CHARACTERISTICS OF INPUT IMAGE SIGNAL

SUBMISSION OF APPEAL BRIEF

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith please find an Appeal Brief. The statutory fee of $500.00 is to be charged to Deposit Account No. 19-4880. The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account. A duplicate copy of this paper is attached.

Respectfully submitted,

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WASHINGTON OFFICE
23373
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Date: September 6, 2006

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APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37, Appellant submits the following:

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I. REAL PARTY IN INTEREST

The real party in interest is FUJI PHOTO FILM CO., LTD., the assignee of the present application. The assignment was recorded on October 17, 2001 at Reel No. 012272, Frame No. 0515.

II. RELATED APPEALS AND INTERFERENCES

Appellant, Appellant's legal representatives, and the assignee in this application are not aware of any other pending appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the instant appeal.

III. STATUS OF CLAIMS

A Final Office Action (Paper Number 20050930), rejecting claims 1-13, 20, 21 and 32-41, objecting to claims 22-31 and allowing claims 14-19, was issued on October 6, 2005, in this application. Appellant submitted an Amendment under 37 C.F.R. § 1.116 on April 6, 2006, amending claims 22-26 and 32-36. In the Advisory Action of April 24, 2006 (Paper Number 20060420), the Examiner indicated that the April 6 Amendment was not entered.

Accordingly, claims 1-41 are all the claims pending in the application. Claims 14-19 are allowed.

Claims 1-3, 7-13, 20, 21 and 37-41 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,461,655 to Vuylsteke *et al.*

Claims 4 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,461,655 to Vuylsteke *et al.* in view of U.S. Patent No. 6,173,084 to Aach *et al.*

Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,461,655 to Vuylsteke *et al.* in view of U.S. Patent No. 5,351,305 to Wood *et al.*

Claims 32-36 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite[1].

Claims 22-31 stand objected to for depending on a rejected base claim.

No other grounds of rejection or objection are currently pending.

This appeal is directed to rejected claims 1-13, 20, 21 and 37-41.

[1] The §112 rejection of claims 32-36 will be addressed upon resolution of rejections over the prior art.

IV. STATUS OF AMENDMENTS

There are no outstanding non-entered amendments to the claims.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention relates to a method and apparatus for suppressing noise in an image signal representing a radiographic image. (Specification at page 2, lines 16-18.)

An embodiment of the invention, as set forth in independent claim 1, provides an apparatus (*100, Figs. 1 and 5*) for suppressing noise in an input image signal (*Sin, Figs. 1 and 5, Specification at page 28. line 6, to page 29, line 13*) representing a radiographic image. The apparatus (*100, Fig. 1 and 5*) comprises a smoothing unit (*3, Figs. 1 and 5, Specification at page 28, lines 17-25*) which processes said input image signal (*Sin, Figs. 1 and 5*) by using a smoothing filter (*Specification at page 32, line 20, to page 33, line 21; illustrative, non-limiting example filters are an anisotropic filter, Specification at page 55, line 8, to page 57, line 26, Figs. 12A-12E, 13A-13E and 14A-14E; and an isotropic filter, Figs. 10A-10C*) so as to smooth said radiographic image, The apparatus (*100, Fig. 1 and 5*) also comprises a characteristic calculation unit (*2, Fig. 1*) which obtains at least one first characteristic (*e.g. density or pixel vectors, Specification at page 11, lines 13-15, at page 37, line 21, to page 38, line 8, Fig. 6A-6C*) of said input image signal (*Sin, Figs. 1 and 5*) by calculation using a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on first information (*illustrative, non-limiting example first information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The smoothing unit (*3, Figs. 1 and* 5) adapts at least one second characteristic (*illustrative, non-limiting examples of the second characteristic are effective area of the filter (mask size) and degree of directionality of the filter (center angle), Specification at page 53, line 15, to page 54, line 13*) of the smoothing filter (*illustrative, non-limiting example filters are an*

anisotropic filter and an isotropic filter) to said input image signal (*Sin, Figs. 1 and 5*) based on said at least one first characteristic (*e.g. density or pixel vectors*).

The present invention also relates to a method for suppressing noise in an input image signal (*Sin, Figs. 1 and 5*) representing a radiographic image, as set forth in independent claim 7. The method comprises obtaining at least one first characteristic (*e.g. density or pixel vectors, Specification at page 11, lines 13-15, at page 37, line 21, to page 38, line 8, Fig. 6A-6C*) of said input image signal (*Sin, Figs. 1 and 5*) by calculation using a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The method also comprises adapting at least one second characteristic (*illustrative, non-limiting examples of the second characteristic are effective area of the filter (mask size) and degree of directionality of the filter (center angle), Specification at page 53, line 15, to page 54, line 13*) of a smoothing filter (*Specification at page 32, line 20, to page 33, line 21; illustrative, non-limiting example filters are an anisotropic filter, Specification at page 55, line 8, to page 57, line 26, Figs. 12A-12E, 13A-13E and 14A-14E; and an isotropic filter, Figs. 10A-10C*) to said input image signal (*Sin, Figs. 1 and 5*) based on said at least one first characteristic (*e.g. density or pixel vectors*). The method comprises processing said input image signal (*Sin, Figs. 1 and 5*) by using said smoothing filter (*illustrative, non-limiting example filters are an anisotropic filter and an isotropic filter*) so as to smooth said radiographic image.

Another embodiment of the invention, as set forth in independent claim 8, relates to a computer-readable storage medium storing a program (*Specification at page 13, lines 11-15*) which instructs a computer to execute a method for suppressing noise in an input image signal

(*Sin, Figs. 1 and 5*) representing a radiographic image. The method comprises obtaining at least one first characteristic (*e.g. density or pixel vectors, Specification at page 11, lines 13-15, at page 37, line 21, to page 38, line 8, Fig. 6A-6C*) of said input image signal (*Sin, Figs. 1 and 5*) by calculation using a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The method also comprises adapting at least one second characteristic (*illustrative, non-limiting examples of the second characteristic are effective area of the filter (mask size) and degree of directionality of the filter (center angle), Specification at page 53, line 15, to page 54, line 13*) of a smoothing filter (*Specification at page 32, line 20, to page 33, line 21; illustrative, non-limiting example filters are an anisotropic filter, Specification at page 55, line 8, to page 57, line 26, Figs. 12A-12E, 13A-13E and 14A-14E; and an isotropic filter, Figs. 10A-10C*) to said input image signal (*Sin, Figs. 1 and 5*) based on said at least one first characteristic (*e.g. density or pixel vectors*). The method comprises processing said input image signal (*Sin, Figs. 1 and 5*) by using said smoothing filter (*illustrative, non-limiting example filters are an anisotropic filter and an isotropic filter*) so as to smooth said radiographic image.

The present invention also relates to a method for suppressing noise in an input image signal (*Sin, Fig. 3*) representing a radiographic image, as set forth in independent claim 9. The method comprises generating (*e.g., by using Laplacian pyramid decomposition, S21, Fig. 2*) a plurality of band-limited image signals (*B1...Bn, Fig. 3*) respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands (*Fig. 3, Specification at page 34, line 2, to page 35, line 16*), based on said input image signal (*Sin, Fig. 3*). The

method also comprises obtaining at least one first characteristic (*e.g. density or pixel vectors, Specification at page 11, lines 13-15, at page 37, line 21, to page 38, line ; Fig. 6A-6C; S22, Fig. 2*) of said input image signal (*Sin, Fig. 3*) by calculation using a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The method comprises adapting at least one second characteristic (*illustrative, non-limiting examples of the second characteristic are effective area of the filter (mask size) and degree of directionality of the filter (center angle), Specification at page 53, line 15, to page 54, line 13; another illustrative, non-limiting example of a second characteristic is a vector average, Specification at page 31, line 17, to page 32, line 1,;S23 and S24, Fig. 2*) of a smoothing filter (*Specification at page 32, line 20, to page 33, line 21; illustrative, non-limiting example filters are an anisotropic filter, Specification at page 55, line 8, to page 57, line 26, Figs. 12A-12E, 13A-13E and 14A-14E; and an isotropic filter, Figs. 10A-10C*) to said input image signal (*Sin, Fig. 3*) based on said at least one first characteristic (*e.g. density or pixel vectors*). The method comprises processing said plurality of band-limited image signals (*B1...Bn, Fig. 3*) by using said smoothing filter (*illustrative, non-limiting example filters are an anisotropic filter and an isotropic filter*) so as to smooth each of said plurality of band-limited images.

An embodiment of the invention, as set forth in claim 10, relates to a computer-readable storage medium storing a program (*Specification at page 14, line 24, to page 15, line 17*) which instructs a computer to execute a method for suppressing noise in an input image signal (*Sin, Fig. 3*) representing a radiographic image. The method comprises generating (*e.g., by using Laplacian pyramid decomposition, S21, Fig. 2*) a plurality of band-limited image signals

(*B1...Bn, Fig. 3*) respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands (*Fig. 3, Specification at page 34, line 2, to page 35, line 16*), based on said input image signal (*Sin, Fig. 3*). The method also comprises obtaining at least one first characteristic (*e.g. density or pixel vectors, Specification at page 11, lines 13-15, at page 37, line 21, to page 38, line ; Fig. 6A-6C; S22, Fig. 2*) of said input image signal (*Sin, Fig. 3*) by calculation using a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The method comprises adapting at least one second characteristic (*illustrative, non-limiting examples of the second characteristic are effective area of the filter (mask size) and degree of directionality of the filter (center angle), Specification at page 53, line 15, to page 54, line 13; another illustrative, non-limiting example of a second characteristic is a vector average, Specification at page 31, line 17, to page 32, line 1,;S23 and S24, Fig. 2*) of a smoothing filter (*Specification at page 32, line 20, to page 33, line 21; illustrative, non-limiting example filters are an anisotropic filter, Specification at page 55, line 8, to page 57, line 26, Figs. 12A-12E, 13A-13E and 14A-14E; and an isotropic filter, Figs. 10A-10C*) to said input image signal (*Sin, Fig. 3*) based on said at least one first characteristic (*e.g. density or pixel vectors*). The method comprises processing said plurality of band-limited image signals (*B1...Bn, Fig. 3*) by using said smoothing filter (*illustrative, non-limiting example filters are an anisotropic filter and an isotropic filter*) so as to smooth each of said plurality of band-limited images.

The present invention also relates to the apparatus (*100, Figs. 1 and 5*) for suppressing noise in an input image signal (*Sin, Fig. 3*) representing a radiographic image, as set forth in

independent claim 11. The apparatus comprises a band-limited-image-signal generation unit (*1, Figs. 1, 3 and 5*) which generates (*e.g., by using Laplacian pyramid decomposition, S21, Fig. 2*) a plurality of band-limited image signals (*B1...Bn, Figs. 3 and 5*) respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands (*Fig. 3, Specification at page 34, line 2, to page 35, line 16*), based on said input image signal. The apparatus (*100, Figs. 1 and 5*) comprises an index-value obtaining unit (*2, Figs. 1 and 5, Specification at page 16, line 7, to page 17, line 19*) which obtains at least one index value (*illustrative, non-limiting example of an index value are a degree C of edge confidence, an index E of pixel energy and an edge orientation, Specification at page 36, lines 8-12*) indicating a degree of suppression of said noise, the at least one index value corresponding to a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The apparatus also comprising a noise suppression unit (*3, Figs. 1 and 5*) which processes each of said plurality of band-limited image signals (*B1...Bn, Fig. 5*) so as to suppress noise in each of said plurality of band-limited images based on said at least one index value (*illustrative, non-limiting example of an index value are a degree C of edge confidence, an index E of pixel energy and an edge orientation*).

The present invention also relates to a method for suppressing noise in an input image signal (*Sin, Fig. 3*) representing a radiographic image, as set forth in independent claim 20. The method comprises generating (*e.g., by using Laplacian pyramid decomposition, S21, Fig. 2*) a plurality of band-limited image signals (*B1...Bn, Fig. 5*) respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands (*Fig. 3, Specification*

at page 34, line 2, to page 35, line 16), based on said input image signal. The method also comprises obtaining at least one index value (*illustrative, non-limiting example of an index value are a degree C of edge confidence, an index E of pixel energy and an edge orientation, Specification at page 36, lines 8-12*) indicating a degree of suppression of said noise, the at least one index value corresponding a function (*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The method comprises processing each of said plurality of band-limited image signals (*Sin, Fig. 3*) so as to suppress noise in each of said plurality of band-limited images based on said at least one index value (*illustrative, non-limiting examples of an index value are a degree C of edge confidence, an index E of pixel energy and an edge orientation*).

The present invention, as set forth in independent claim 21, also relates to a computer-readable storage medium storing a program (*Specification at page 23, lines 14-16*) which instructs a computer to execute a method for suppressing noise in an input image signal (*Sin, Fig. 3*) representing a radiographic image. The method comprises generating (*e.g., by using Laplacian pyramid decomposition, S21, Fig. 2*) a plurality of band-limited image signals (*B1...Bn, Fig. 5*) respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands (*Fig. 3, Specification at page 34, line 2, to page 35, line 16*), based on said input image signal. The method also comprises obtaining at least one index value (*illustrative, non-limiting example of an index value are a degree C of edge confidence, an index E of pixel energy and an edge orientation, Specification at page 36, lines 8-12*) indicating a degree of suppression of said noise, the at least one index value corresponding to a function

(*illustrative, non-limiting example functions are provided at page 55, line 8, to page 57, line 26*) based on information (*illustrative, non-limiting example information include items a-e at page 54, line 14, to page 55, line 1*) indicating an exposure dose with which said radiographic image has been produced. The method comprises processing each of said plurality of band-limited image signals (*B1...Bn, Fig. 5*) so as to suppress noise in each of said plurality of band-limited images based on said at least one index value (*illustrative, non-limiting examples of an index value are a degree C of edge confidence, an index E of pixel energy and an edge orientation*).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1) Whether claims 1-3, 7-13, 20, 21 and 37-41 are unpatentable under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,461,655 to Vuylsteke *et al.* ["Vuylsteke"].

2) Whether claims 4 and 5 are unpatentable under 35 U.S.C. § 103(a) as being obvious over Vuylsteke in view of U.S. Patent No. 6,173,084 to Aach *et al.* ["Aach"].

3) Whether claim 6 is unpatentable under 35 U.S.C. § 103(a) as being obvious over Vuylsteke in view of U.S. Patent No. 5,351,305 to Wood *et al.* ["Wood"].

VII. ARGUMENT

A. Claims 1-13, 20, 21 and 37-41

Claim 1 recites an apparatus for suppressing noise in an input image signal representing a radiographic image that comprises "a smoothing unit which processes said input image signal by using a smoothing filter so as to smooth said radiographic image; and a characteristic calculation unit which obtains at least one first characteristic of said input image signal by calculation using a function based on first information indicating an exposure dose with which said radiographic image has been produced; said smoothing unit adapts at least one second characteristic of the smoothing filter to said input image signal based on said at least one first characteristic." (emphasis added.)

Based on the cited sections (col. 8,lines 39-67 of Vuylsteke) the Examiner is contending that pixel values of difference images bi and noise variance V_n correspond to the claimed first information indicating an exposure dose and the claimed first characteristic, respectively. (Final Office Action, paper number 20050930, at page 3.)

Appellant disagrees.

The system of Vuylsteke is illustrated in Figs. 4a, 4b and 5.

In Fig. 4a, down-sampling is performed on an original image (2) using a low-pass filter, and a first reduced image (g_1) is produced. The first reduced image (g_1) is further reduced in a similar manner, and a second reduced image (g_2) is produced. This process is repeated a predetermined number of times until the smallest reduced image (g_L) is produced.

In addition, the first reduced image (g_1) is enlarged to the size of the original image, and the enlarged image is subtracted from the original image to produce a difference image (b_0). The difference image (b_0) represents high frequency component information (contrast information),

which has been lost from the original image in the reduction/enlargement process (a smooth image is obtained using a low-pass filter in the reduction/enlargement process). Difference images (b_1) through (b_{L-1}) are produced in a similar manner. Therefore, L difference images, namely difference images (b_0) through (b_{L-1}) and a single reduced image (g_L) are produced.

In Fig. 4b, Vuylsteke discloses that the reduced image g_1 is enlarged to the size of the difference image b_{L-1}, and a first addition image is produced by adding the enlarged image to the difference image b_{L-1}. Then, the first addition image is enlarged to the size of the difference image b_{L-2}, and the difference image b_{L-2} is added to the enlarged image to produce a second addition image. This process is repeated up to the original image size. Accordingly, the original image can be restored.

In Vuylsteke, noise is suppressed by performing the process illustrated in Fig. 5. The noise suppression is performed between the down-sampling process of Fig. 4a and the enlargement process of Fig. 4b. Although Fig. 5 discloses an image g_L, which may have pixel values corresponding to the exposure dose, the image g_L is not used to perform the actual noise suppression.

Vuylsteke discloses that the noise reduction section 32 receives the difference images bi (where i = 0, 1, ...L-1). (Fig. 5.) The neighborhood average v of squared pixel values of the difference images bi is calculated for each pixel and a histogram based on the neighborhood average v of the squared pixel values of the difference images bi is generated. A noise variance Vn for each difference image bi is obtained from the histogram where Vn represents the highest variance value for the difference image bi. Hereinafter, the neighborhood average v of squared pixel values is referred to as a "squared neighborhood average v." Then, a noise suppression

level is calculated, based on equation 1 (col. 9, lines 44-49), which depends on the noise variance value Vn, and the squared neighborhood average v.

As used in the disclosure of Vuylsteke, the term "variance" represents the value of a pixel in a difference image such as, for example, image b_0. The value of the pixel is a difference (m - x) between the pixel value x of a pixel in the original image and the pixel value m of a pixel in an image after the low pass filter, i.e., the image without high frequency components. In the system of Vuylsteke, the pixel value m is a value obtained by smoothing (neighborhood averaging). The average of the squares of the pixel values of pixels in the difference image (i.e., ∑(m – x)^2/ N) corresponds to a variance value with respect to the original image.

Although the Examiner concedes that the pixel value of the difference image is not equal to the exposure dose (Advisory Action, paper number 20060420, at page 2), the Examiner still appears to confuse the pixel value in the difference image of Vuylsteke with a pixel value that represents or is an indication of a radiation exposure dose. The Examiner contends that because the pixel values of difference images bi (the alleged first information) are derived from the original image, "the pixels values of bi are also indicative of the exposure dose." (Advisory Action, paper number 20060420, at page 2.)

The system in Vuylsteke first calculates a squared neighborhood average v of the pixel values of all pixels in the difference image bi to extract only signal components from the pixel values, which includes both edge components and noise components, of the difference image bi by separating the noise components therefrom. Then, a value with the highest occurrence is calculated by analyzing a histogram about the squared neighborhood averages v of the difference images bi. The obtained Vn is used as a standard noise amount (noise variance), and components which have higher noise amount than the standard noise amount (Vn) among the

squared neighborhood averages v of the difference image bi are judged as edge signals (a non-linear function, such as the noise suppression lookup table 71 in Figure 5 or a function illustrated in Figure 7, is actually used).

Therefore, Vuylsteke merely discloses the use of a histogram of the squared neighborhood average v of the difference images bi to calculate the noise variance Vn corresponding to a difference image representing a certain frequency band as a single value. Because the squared neighborhood averages v of the difference images bi depend on the edge signal amount and the noise amount of the original image, the shape of the histogram is directly dependent on the edge signals and the noise in the image. Therefore, the shape of the histogram of an image including a large amount of noise will be different from the shape of a histogram of an image with small amount of noise. Accordingly, the shape of the histogram does not reflect the amount of exposure dose. This is because the difference image bi is created by subtracting a smoothed image from the original image as described above, the pixel value of a difference image bi does not depend on an exposure dose.

Specifically, the value of a pixel in an edge portion of the difference image bi represents an edge. When the value of a pixel in a non-edge portion of the difference image bi is a value other than 0, the value of the pixel in the non-edge portion represents noise. Therefore, Appellant submits that the processing disclosed in Vuylsteke, which depends on a value, i.e., noise variance Vn, calculated based on the original image does not disclose or suggest the claimed calculation using a function based on first information indicating an exposure dose. That is, the pixel value of the difference image bi (the alleged first information) does not contain information of the exposure dose for the reasons given above.

Therefore, contrary to the Examiner's contentions, the pixels values of difference images bi are not indicative of the exposure dose, and Appellant submits that Vuylsteke does not disclose or suggest the claimed characteristic calculation unit which obtains at least one first characteristic of the input image signal by calculation using a function based on first information indicating an exposure dose, as set forth in claim 1.

Appellant submits that independent claims 7-11, 20 and 21 are patentable for reasons analogous to those given above with respect to claim 1.

Appellant submits that claims 2, 3, 12, 13 and 37-41 are patentable at least by virtue of their respective dependencies.

B. Claim 4 and 5

Because Aach does not cure the deficient teachings of Vuylsteke given above with respect to claim 1, Appellant submits that claims 4 and 5 are patentable at least by virtue of their dependency on claim 1.

C. Claim 6

Because Wood does not cure the deficient teachings of Vuylsteke given above with respect to claim 1, Appellant submits that claim 6 is patentable at least by virtue of its dependency.

Unless a check is submitted herewith for the fee required under 37 C.F.R. §41.37(a) and 1.17(c), please charge said fee to Deposit Account No. 19-4880.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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Date: September 6, 2006

CLAIMS APPENDIX

CLAIMS 1-13, 20, 21 and 37-41 ON APPEAL:

1. An apparatus for suppressing noise in an input image signal representing a radiographic image, comprising:

a smoothing unit which processes said input image signal by using a smoothing filter so as to smooth said radiographic image; and

a characteristic calculation unit which obtains at least one first characteristic of said input image signal by calculation using a function based on first information indicating an exposure dose with which said radiographic image has been produced;

said smoothing unit adapts at least one second characteristic of the smoothing filter to said input image signal based on said at least one first characteristic.

2. An apparatus according to claim 1, further comprising a band-limited-image-signal generation unit which generates a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal,

said smoothing unit processes said plurality of band-limited image signals by using said smoothing filter so as to smooth each of said plurality of band-limited images.

3. An apparatus according to claim 2, wherein said band-limited-image-signal generation unit generates said plurality of band-limited image signals by performing multiresolution decomposition of said input image signal.

4. An apparatus according to claim 2, wherein said characteristic calculation unit obtains said at least one first characteristic of said input image signal based on second information locally calculated from pixel values in a neighborhood of a pixel of interest in at least one of said plurality of band-limited images represented by at least one of said plurality of band-limited image signals, as well as said first information.

5. An apparatus according to claim 4, wherein said characteristic calculation unit obtains a pixel vector at said pixel of interest in said at least one of said plurality of band-limited images, and detects an orientation of an edge as said second information, and

said smoothing unit arranges said at least one second characteristic of said smoothing filter so that said radiographic image is smoothed along said orientation of said edge.

6. An apparatus according to claim 1, wherein said smoothing filter includes for each of a plurality of predetermined directions a plurality of filters respectively smoothing said radiographic image in said each of a plurality of predetermined directions to a plurality of different degrees, and

said smoothing unit adapts said at least one second characteristic of said smoothing filter to said input image signal by selecting one of said plurality of filters based on said at least one first characteristic of said input image signal.

7. A method for suppressing noise in an input image signal representing a radiographic image, said method comprising the steps of:

(a) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced;

(b) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic; and

(c) processing said input image signal by using said smoothing filter so as to smooth said radiographic image.

8. A computer-readable storage medium storing a program which instructs a computer to execute a method for suppressing noise in an input image signal representing a radiographic image, said method comprising the steps of:

(a) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced;

(b) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic; and

(c) processing said input image signal by using said smoothing filter so as to smooth said radiographic image.

9. A method for suppressing noise in an input image signal representing a radiographic image, said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal;

(b) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced;

(c) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic; and

(d) processing said plurality of band-limited image signals by using said smoothing filter so as to smooth each of said plurality of band-limited images.

10. A computer-readable storage medium storing a program which instructs a computer to execute a method for suppressing noise in an input image signal representing a radiographic image, said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal;

(b) obtaining at least one first characteristic of said input image signal by calculation using a function based on information indicating an exposure dose with which said radiographic image has been produced;

(c) adapting at least one second characteristic of a smoothing filter to said input image signal based on said at least one first characteristic; and

(d) processing said plurality of band-limited image signals by using said smoothing filter so as to smooth each of said plurality of band-limited images.

11. An apparatus for suppressing noise in an input image signal representing a radiographic image, comprising:

a band-limited-image-signal generation unit which generates a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal;

an index-value obtaining unit which obtains at least one index value indicating a degree of suppression of said noise, the at least one index value corresponding to a function based on information indicating an exposure dose with which said radiographic image has been produced; and

a noise suppression unit which processes each of said plurality of band-limited image signals so as to suppress noise in each of said plurality of band-limited images based on said at least one index value.

12. An apparatus according to claim 11, wherein said index-value obtaining unit obtains said at least one index value indicating the degree of suppression of the noise for each of said plurality of band-limited image signals, and

said noise suppression unit processes each of said plurality of band-limited image signals so as to suppress the noise in each of said plurality of band-limited images based on said at least one index value obtained for said each of said plurality of band-limited image signals.

13. An apparatus according to claim 11, wherein said index-value obtaining unit obtains said at least one index value indicating the degree of suppression of the noise for each pixel of each of said plurality of band-limited images, and

said noise suppression unit processes each of said plurality of band-limited image signals so as to suppress noise in said each pixel of each of said plurality of band-limited images based on said at least one index value obtained for said each pixel of said each of said plurality of band-limited images.

20. A method for suppressing noise in an input image signal representing a radiographic image, said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal;

(b) obtaining at least one index value indicating a degree of suppression of said noise, the at least one index value corresponding a function based on information indicating an exposure dose with which said radiographic image has been produced; and

(c) processing each of said plurality of band-limited image signals so as to suppress noise in each of said plurality of band-limited images based on said at least one index value.

21. A computer-readable storage medium storing a program which instructs a computer to execute a method for suppressing noise in an input image signal representing a radiographic image, said method comprising the steps of:

(a) generating a plurality of band-limited image signals respectively representing a plurality of band-limited images belonging to a plurality of different frequency bands, based on said input image signal;

(b) obtaining at least one index value indicating a degree of suppression of said noise, the at least one index value corresponding to a function based on information indicating an exposure dose with which said radiographic image has been produced; and

(c) processing each of said plurality of band-limited image signals so as to suppress noise in each of said plurality of band-limited images based on said at least one index value.

37. The apparatus of claim 1, wherein the function is defined by at least a signal value of a pixel and an amount of the exposure dose of the radiographic image.

38. The method of claim 7, wherein the function is defined by at least a signal value of a pixel and an amount of the exposure dose of the radiographic image.

39. The method of claim 9, wherein the function is defined by at least a signal value of a pixel and an amount of the exposure dose of the radiographic image.

40. The apparatus of claim 11, wherein the function is defined by at least a signal value of a pixel and an amount of the exposure dose of the radiographic image.

41. The method of claim 20, wherein the function is defined by at least a signal value of a pixel and an amount of the exposure dose of the radiographic image.

EVIDENCE APPENDIX:

NONE.

RELATED PROCEEDINGS APPENDIX

NONE.